

REMARKS

The rejection of Claims 1-32 under 35 U.S.C. § 103(a) as unpatentable over U.S. 5,380,933 (Ushikubo et al) in view of EP 1193240 (Bogan et al), is respectfully traversed.

As recited in Claim 1 herein, the present invention is a process for heterogeneously catalyzed partial direct oxidation of propane and/or isobutane to at least one of the target products acrylic acid, methacrylic acid, by feeding a starting reaction gas mixture comprising propane and/or isobutane, molecular oxygen and at least one inert diluent gas and having a inlet pressure P^1 to a reaction stage which, apart from an inlet for the starting reaction gas mixture, optionally further inlets for auxiliary gases, and an outlet for the product gas mixture, is sealed on the gas side, in the reaction stage directly oxidizing the propane and/or isobutane present in the starting reaction gas mixture partially to at least one target product by passing the starting reaction gas mixture at elevated temperature over a solid state catalyst, and conducting the reaction gas mixture as a product gas mixture comprising at least one target product and having the outlet pressure P^2 out of the reaction stage and, with this pressure P^2 , into a workup stage which, apart from an inlet for the product gas mixture, optionally further inlets for auxiliary gases, and an outlet for the residual product gas mixture, is sealed on the gas side, in the workup stage basically separating target product present in the product gas mixture of the reaction stage from said product gas mixture into a liquid phase and conducting the remaining residual product gas mixture which comprises not only propane and/or isobutane and also in some cases propene and/or isobutene and has the outlet pressure P^3 , where $P^3 < P^1$, out of the workup stage and recycling propane and/or isobutane present in the residual product gas mixture into the reaction stage, which comprises selecting P^1 in such a way that $P^3 \geq 1.5$ bar and dividing the residual product gas mixture into two portions of the same composition and discharging one portion as output and recycling the other portion as

cycle gas and feeding it back to the reaction stage, compressed to the inlet pressure P^1 , as a constituent of the starting reaction gas mixture.

The key features of the presently-claimed process are as follows:

1. After separating the target product from the product gas mixture, no further separation of the propane and/or isobutane from the gas mixture is carried out, but the remaining mixture is simply divided into two portions of identical composition and one of these portions is recycled to the reaction zone.
2. The reaction is carried out at an inlet pressure, $P^1 > 1.5$ bar.
3. The outlet pressure of the workup stage, $P^3 \geq 1.5$ bar.
4. The outlet pressure of the reaction stage, P^2 , is the inlet pressure for the workup stage.

An important precondition for fulfillment of above features 2 and 3 is feature 1. The claimed process is beneficial due to recycling the propane and/or isobutane-containing residual product gas mixture that remains after separating the target product from the product gas mixture without previously separating propane and/or isobutane in the process. By avoiding such early separation, significant pressure losses, resulting in costly compression requirements, are avoided.

The applied prior art neither discloses nor suggests the above-discussed features. Rather, Ushikubo et al simply discloses the basic vapor phase catalytic oxidation of, for example, propane or isobutane to form the corresponding unsaturated carboxylic acid in the presence of a catalyst, wherein the invention in Ushikubo et al is drawn to the amount range of essential components of the catalyst. Bogan et al is similar to Ushikubo et al but uses a different (but somewhat similar) catalyst. The Examiner relies on Bogan et al for its disclosure of reaction zone pressure of from 0 to 75 psig [0065] as a basis for carrying out the reaction in Ushikubo et al at this pressure.

In reply, the Examiner has apparently overlooked the disclosure in Ushikubo et al that their reaction can be conducted usually under atmospheric pressure, but may be conducted under a slightly elevated pressure or slightly reduced pressure (sentence bridging columns 5 and 6). Nevertheless, the present invention is not simply carrying out a conventional heterogeneously catalyst partial direct oxidation of propane and/or isobutane at a conventional pressure. Rather, the present invention is directed to the above-discussed features. Thus, Ushikubo et al discloses and suggests nothing that would inform a person of ordinary skill in the art that high pressure is beneficial in the reaction stage, or that any recycling of raw material would be beneficial, nor does it provide any hint of at which pressure the workup of the product gas should be carried out or what the outlet pressure of the worked-up product should be. Similarly, Bogan et al is silent with regard to pressure during purification or at its outlet.

For all the above reasons, it is respectfully requested that this rejection be withdrawn.

The rejection of Claims 1-14 and 17-32 under 35 U.S.C. § 112, first paragraph, as failing to satisfy the enablement requirement thereof, is respectfully traversed. It should be clear from the discussion of the prior art rejection, above, that the present invention is based on various pressures at various points in the process, combined with separation and recycle of product mixtures. The invention is not limited to particular catalysts and indeed, the number of catalysts known for heterogeneously catalyzed partial direct oxidation of propane and/or isobutane to form (meth)acrylic acid is vast. It is clear from the specification as a whole that the presently-claimed invention could be carried out with any such catalyst. Indeed, Applicants disclose in the specification at page 9, lines 27-29 that “[u]seful catalysts for the process according to the invention are in principle all of those which are recommended in the prior art for the heterogeneously catalyzed partial direct oxidation of propane and/or

isobutane to at least one of the target products.” Accordingly, it is respectfully requested that this rejection be withdrawn.

All of the presently-pending claims in this application are believed to be in immediate condition for allowance. Accordingly, the Examiner is respectfully requested to pass this application to issue.

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